REMARKS

Favorable consideration and allowance of the present application are respectfully requested in view of the following remarks.

Currently, claims 1-2, 4-13, 42, and 44-63 are pending in the present application, including independent claims 1, 46, and 48-50. Independent claim 1, for example, is directed to a method for heat treating a semiconductor wafer. The wafer is placed in a thermal processing chamber that is in communication with a plurality of lamps, and the wafer defines a plurality of localized regions along a radial axis. The temperature of the semiconductor wafer is adjusted to a predetermined temperature according to a predetermined heat cycle, and this heat cycle includes a heating stage during which the semiconductor wafer is heated by the plurality of lamps. During at least one stage of the heat cycle, a gas is provided to selectively control the temperature of at least one of the localized regions of the semiconductor wafer, which minimizes temperature deviation of the localized region(s) from the predetermined temperature.

Various advantages and benefits are achieved through this method. For instance, the temperature profile of the semiconductor wafer can be maintained at a substantially uniform temperature throughout the entire predetermined heating cycle, which may include ramp-up, steady state, and ramp-down stages. Moreover, by maintaining the temperature profile of the wafer at substantially uniform temperatures, the resulting method can be used, for example, to effectively anneal a silicon wafer and/or thin films or layers formed thereon, as well as to form ultra-thin coatings and films on the wafer.

Claims 1, 2, 5, 8-13, 44-45, 48, 50-51, 53, 56-60, and 62-63, which include independent claims 1, 48, and 50, were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,814,365 to Mahawili. Mahawili is directed to a reactor and a method for processing a semiconductor substrate. The reactor of Mahawili includes a processing chamber that contains an emissivity measuring device and a gas injection system. The emissivity measuring device measures the photon density from a light source, which is housed in the processing chamber, and the reflected photon density off a substrate, which is processed in the processing chamber. The emissivity

measurements are then used in Mahawili to determine the temperature of the substrate. (Col. 2, lines 54-62). The gas injection system in the reactor of Mahawili is adapted to inject and direct at least one gas onto a discrete area of a semiconductor substrate, and this gas injection system may include a plurality of gas injectors that are grouped so that each group of gas injectors injects at least one gas into the processing chamber of the reactor and onto a discrete area of the substrate. (Col. 3, lines 4-10 and 37-58).

However, Mahawili does not teach the method of Applicants' independent claims 1, 48, and 50, wherein, during at least one stage of a predetermined heat cycle, a gas is provided to selectively control the temperature of at least one localized region of a semiconductor wafer to minimize temperature deviation of the region from a predetermined temperature. The gas injection system or assembly (see 34 in Figure 3) in the reactor of Mahawili directs one or more reactant gases to the substrate during processing in a uniform and controlled manner (i.e., to discrete regions of the substrate). (Col. 4, lines 13-16 and 60-65). But this "controlled" gas flow in Mahawili does not selectively control the temperature of a localized region of the substrate.

Rather, the gas injection system of Mahawili is adapted to produce "uniform deposition on the substrate." (Col. 3, lines 53-58). For example, in some embodiments of Mahawili, the gas injection system is broken up into gas injection segments 36, 38, and 40, which introduce one or more gases to a discrete area of substrate 12 through channels (i.e., 36a-d), each of which includes orifices 42. These orifices 42 may be arranged to provide the same flow rate of gas across the width of substrate 12 or may be arranged in a non-uniform pattern to vary the profile of the gas flow across the substrate. Also, the number of orifices 42 and the spacing between those orifices may be adjusted to provide "a more uniform flow or to direct more gas to one area of the substrate than another." (Col. 6, line 13 – col. 7, line 4). Again, no part of Mahawili's gas injection system is related to *temperature control*, particularly the "selective control" of the temperature of at least one localized region of a semiconductor wafer as set forth in Applicants' claims 1, 48, and 50.

In Mahawili, any discussion of "temperature control" of the substrate revolves around Mahawili's heater assembly (i.e., 14 in Figures 2-3 and 6) which is enclosed in

heater housing 16 and includes an array of heating elements such as linear tungsten-halogen lamps. (Col. 4, line 60 – col. 5, line 22). Mahawili states that heater assembly 14 delivers heat to substrate 12 in a uniform manner, for example, by forming a plurality of heating zones which provides a concentrated heating profile with a greater amount of heat being applied to the outer perimeter of the substrate than the center of the substrate.

Further, Mahawili's non-contact emissivity measurement system—for measuring the emissivity and calculating the temperature of substrate 12 during fabrication processes—is involved in "temperature control" in Mahawili. Specifically, photon density sensor 70 measures the incident photon density from light source 72 and measures the reflected photon density off the device side 12a of substrate 12, and eventually the temperature of the substrate is calculated. (Col. 8, line 44 – col. 9, line 60). Temperature readings taken in Mahawili may be used to deliver proportional power to each of the lamp zones within heater assembly 14 and, more generally, to monitor and control the output of heater assembly 14 or to adjust the profile of the applied heat. (Col. 9, lines 26-55; col. 10, lines 28-34). Again, however, these aspects of "temperature control" in Mahawili are completely unrelated to *providing a gas* to selectively control the temperature of at least one localized region of a semiconductor wafer to minimize temperature deviation of the region from a predetermined temperature.

Applicants respectfully submit, then, that independent claims 1, 48, and 50 are not anticipated by Mahawili at least for the reason that Mahawili does not disclose the providing of a gas to selectively control the temperature of at least one localized region of a semiconductor wafer to minimize temperature deviation of the region from a predetermined temperature.

Additionally, claims 4, 6-7, 42, 46-47, 49, 52, 54-55, and 61, which include independent claims 46 and 49, were rejected under 35 U.S.C. § 103(a) as being unpatentable over Mahawili in view of U.S. Patent No. 5,997,175 to Champetier, et al. The Office Action stated that Mahawili does not "teach that the gas is supplied by a reflective device located below the semiconductor wafer." (Office Action at 5.) In

accordance with the detailed discussion above, Applicants respectfully submit that Mahawili does not disclose, for example, the limitation in claims 46 and 49 requiring that a gas be provided to selectively control the temperature of at least one localized region of a semiconductor wafer to minimize temperature deviation of the region from a predetermined temperature.

Further, the Office Action relies on Champetier, et al. as teaching the use of a reflective device located below the semiconductor wafer. Applicants respectfully submit, however, that as set forth in detail in a previous Response filed on May 30, 2002 for this application, the Champetier, et al. patent is not available as prior art to the present application. In addition, even if certain aspects of Champetier, et al. are considered by the Patent Office to be prior art to the claims of the present application, combining the disclosure of Champetier, et al. with Mahawili does not cure the above-described deficiencies of Mahawili. Champetier, et al. is generally directed to an apparatus for measuring the temperature of a semi-transparent radiating body. For example, the apparatus can include a first reflective device and a second reflective device that are contained within a chamber and positioned such that a radiating body can be placed between both. (Col. 4, lines 42-49). The first and second reflective devices include areas of high reflectivity, which reflect thermal radiation at a selected wavelength that is being emitted by the radiating body. (Col. 4, lines 45-48).

However, Champetier, et al. does not describe providing a gas to selectively control the temperature of at least one of a plurality of localized regions of a semiconductor wafer to minimize temperature deviation of the region(s) from a predetermined temperature. As shown in Fig. 1 of Champetier, et al., for instance, a chamber 12 is provided that includes a gas inlet 18 and a gas outlet 20 for introducing a gas into the chamber and/or for maintaining the chamber within a preset pressure range. (Col 7, lines 34-40). Yet, Applicants note that the gas inlet 18 and gas outlet 20 do not provide selective control over the temperature of a *localized* region. Instead, gas inlet 18 and gas outlet 20 provide a gas to the entire chamber, and not selectively to any particular region of the semiconductor wafer. In short, Applicants respectfully submit

that independent claims 46 and 49 patentably define over Mahawili and Champetier, et al., alone or in any proper combination.

The dependent claims were also rejected as being unpatentable over the references discussed in detail above. Applicant respectfully submits, however, that at least for the reasons indicated above relating to corresponding independent claims 1, 46, and 48-50, the dependent claims patentably define over the references cited in the Office Action. However, Applicant also notes that the patentability of the dependent claims does not necessarily hinge on the patentability of independent claims 1, 46, and 48-50. In particular, it is believed that some or all of the dependent claims may possess features that are independently patentable, regardless of the patentability of claims 1, 46, and 48-50.

In summary, it is respectfully submitted that the claims are patentably distinct over the prior art of record and that the present application is in complete condition for allowance. Favorable action, therefore, is respectfully requested. Examiner Lee is invited and encouraged to telephone the undersigned at her convenience should any issues remain after consideration of the present Response.

Please charge any additional fees required by this Response to Deposit Account No. 04-1403.

Respectfully submitted,

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